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# (54) Controlled illuminated display

(57) A display unit has a transparent front panel 10 one surface 11 of which carries reflective markings 12 to 15 that are illuminated by internal reflection in the panel from edge-mounted bulbs 31 to 34. Behind the panel 10 are located light-emitting display devices 20 and 21 such as provided by LED's. Illumination from the bulbs 31 to 34 is controlled by manually adjusting a rheostat (36). The brightness of the display devices 20 and 21 is controlled by means of two photodiodes 51 and (52). One photodiode (51) responds to the level of ambient light falling on the front panel; the other photodiode (52) is shielded from ambient light and responds to light from an additional bulb (40) connected in parallel with the edge-mounted bulbs and having the same illumination characteristics. The brightness of the display devices 20 and 21 is thereby automatically decreased when ambient light levels fall and increased when the markings 12 to 15 are brightly illuminated, so that they are not masked by bright markings.

Fig.1.

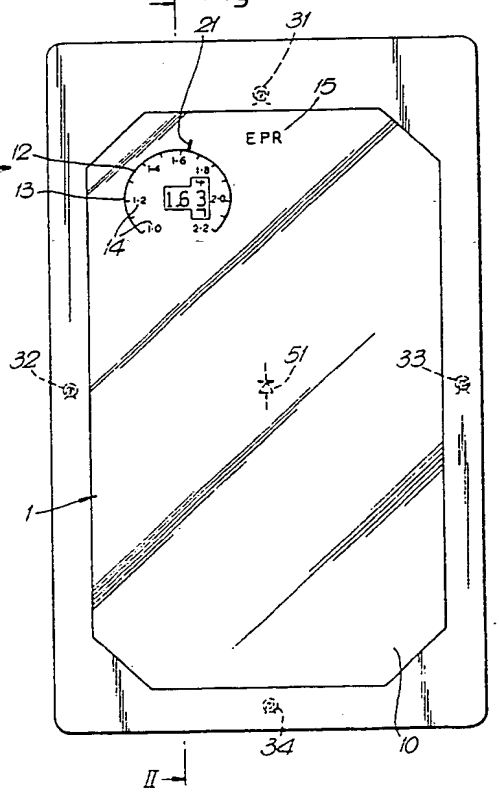



Fig.2.

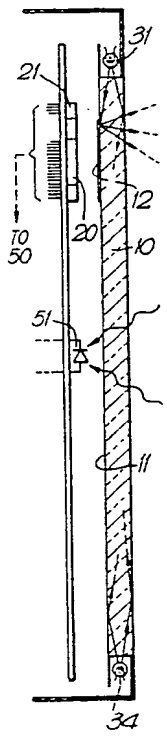


Fig. 1.

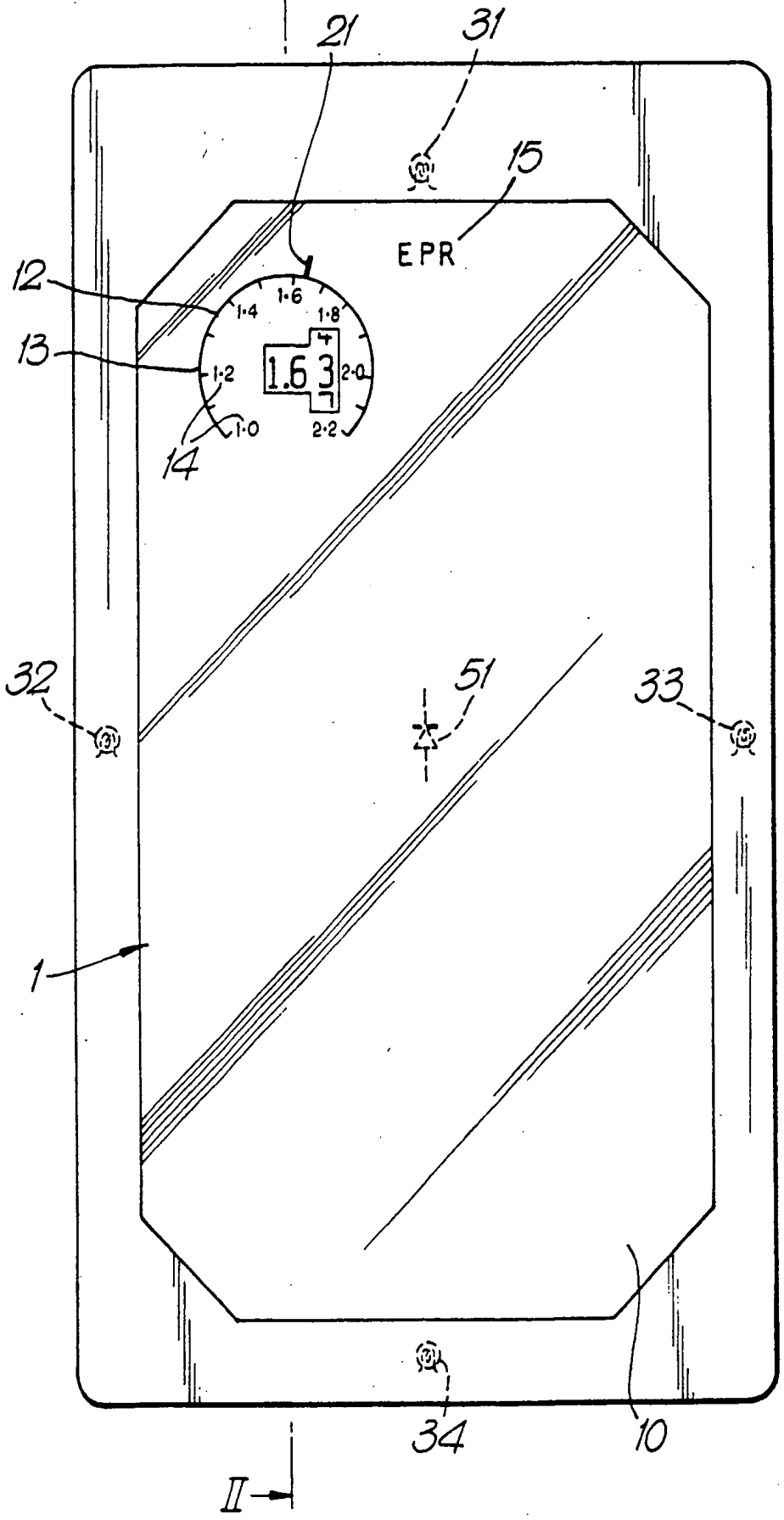

II
21
31
15
EPR
12
13
14
1·4
1·6
1·8
1·2
1.63
2·0
1·0
2·2
32
51
33
1
34
10
II

Fig. 2.

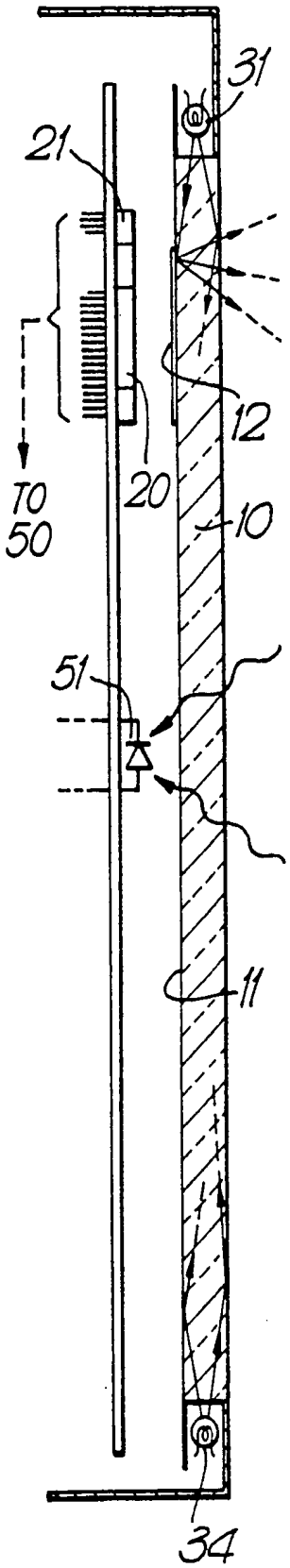
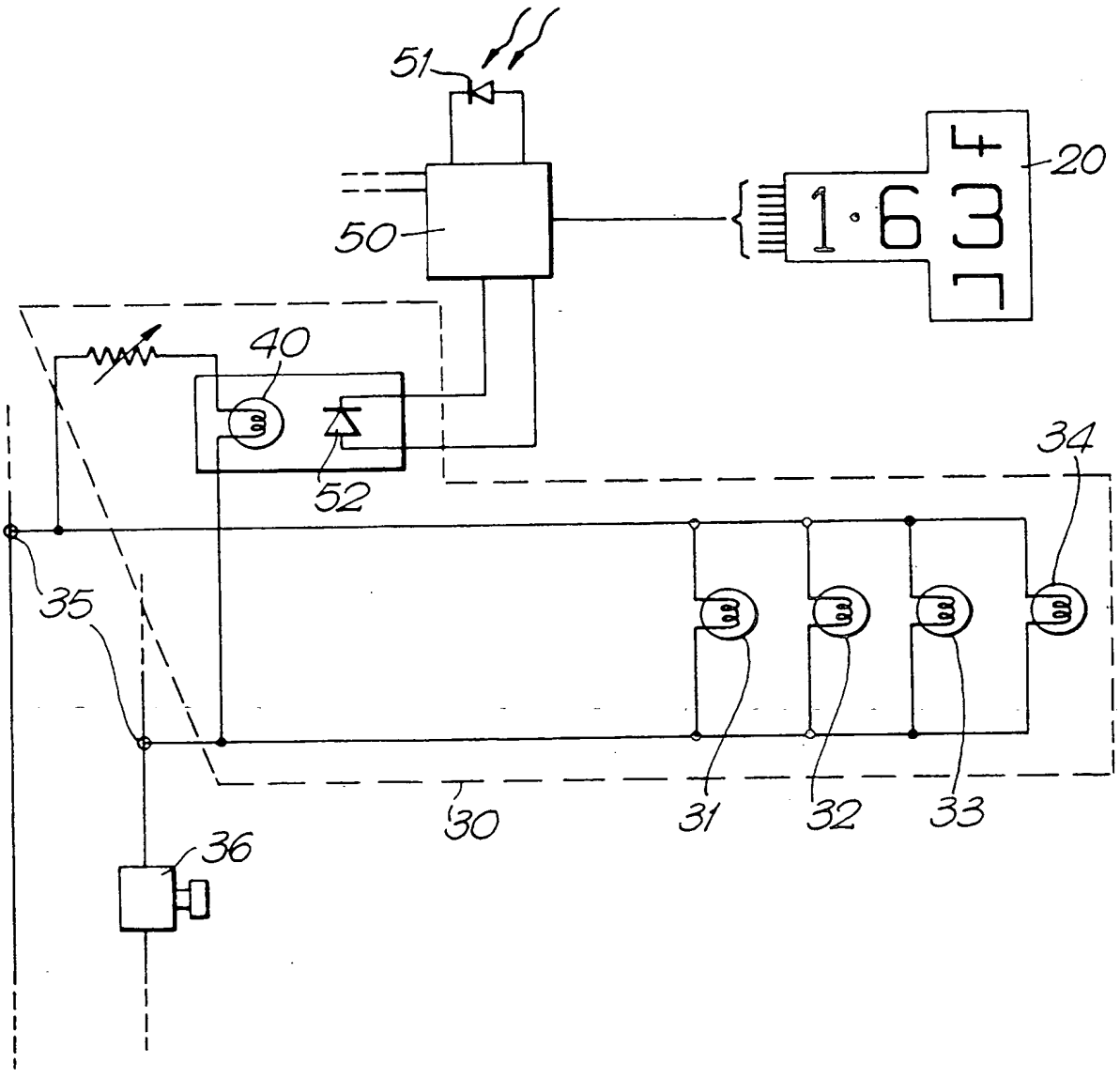

31
21
12
TO
50
20
10
51
11
34

Fig.3.



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# DISPLAY UNITS

This invention relates to display units.

The invention is more particularly concerned with display units in which a display representation is provided by energisation of light-emitting elements together with illumination of light-reflective regions.

Many forms of instruments and other display units include both light-emitting elements, such as light-emitting diodes, and reflective regions such as printed markings. In normal daylight, the light-emitting elements must be sufficiently brightly energised to ensure that they are easily readable, whilst ambient light provides sufficient illumination of the reflective markings or other elements.

In subdued light, the level of energisation of the light-emitting elements is reduced, whilst illumination, in addition to ambient light, may be required of the reflective markings to make them clearly visible.

In night conditions greater illumination of the markings is required whilst a lower brightness level is needed for the light-emitting elements.

For some applications, such as on aircraft flight decks, the control of apparent brightness of the display is very important since both the light-emitting and light-reflective elements must always be clearly visible in conditions that vary from bright sunlight to pitch darkness. It is also important that, in darkness conditions, the brightness of the display does not distract the user from other displays, controls or from faintly illuminated

objects outside the aircraft.

Conventional display units include a light detector responsive to ambient light which is coupled to the drive circuit of the light-emitting elements, so that the brightness of the elements is varied directly in response to ambient light levels. In this way, the light-emitting elements are energised to a higher level at bright ambient light conditions than in dark conditions. The level of illumination of the reflective markings is controlled manually by the user as he desires, so that the markings are more brightly illuminated in dark conditions.

This previous arrangement, however, cannot readily provide a clearly visible display especially at low ambient light levels, because the relatively high level of illumination required for the reflective markings will mask the relatively low brightness of the light-emitting elements produced automatically. This generally results in the user compromising by setting a lower than ideal brightness for the reflecting markings, or by the display being arranged to produce a higher than desirable brightness level for the light-emitting elements.

In some displays, it may be possible to locate the light detector so that it receives both ambient light and light from the source used to illuminate the reflective elements. In such an arrangement, a degree of compensation is automatically provided when ambient light levels are low, and when light levels from the illuminating source are high.

However, in many displays it is not possible to do this, such as, when the reflective elements are markings on a face of a transparent plate that is

edge illuminated through the thickness of the plate.

It is an object of the present invention to provide a display unit that can be used to alleviate these problems.

According to the present invention there is provided a display unit including a light-emitting element, a light-reflective region, first means for illuminating substantially only said light-reflective region, a first light-responsive detector arranged to provide an output indication of the amount of ambient light incident on the unit, a second light-responsive detector shielded from ambient light, second illuminating means arranged to illuminate the second detector, the second illuminating means having the same illumination characteristics as the first illuminating means such that the second detector provides an output indicative of the illumination provided by the first illuminating means, and control means arranged to control the brightness of the light-emitting element in accordance with both the level f ambient light as detected by the first detector and the level of illumination of the light-reflective region as indicated by the second detector.

The first illuminating means and the second illuminating means are preferably connected in parallel and may include filament bulbs. The unit may include a device by which the first illuminating means can be manually adjusted. The light-reflective region may be marking on a face of a transparent plate, preferably the rear face, the first illuminating means being located at an edge of the plate to direct light transversely through the plate onto the marking. The plate may be located in front of the light-emitting element. The light reflecting region may be provided by reflective marking indicia against which the display representation of the light-emitting

element is provided.

An aircraft display unit according to the present invention will now be described, by way of example, with reference to the accompanying drawings, in which:

Figure 1 is a front elevation showing the front panel of the unit;

Figure 2 is a sectional side elevation along the line II-II of Figure 1, showing a part of the display unit; and

Figure 3 illustrates schematically the electrical circuits in the display unit.

With reference first to Figures 1 and 2, the aircraft display unit has a front panel 1 on which a display representation of various aircraft performance variables are provided. The front panel 1 comprises a transparent glass plate 10 on the rear face 11 of which is printed various reflective markings or regions 12. In Figure 1 these markings take the form of an arcuate scale 13 with printed numbers 14 at points along the scale, and various printed legends 15. Just behind the panel 1 there are mounted various light-emitting devices 20 and 21 that are visible through the panel. One of these devices 20 takes the form of a matrix array of light-emitting diodes which provides a numerical display, such as described in GB 2016781B, centrally within the arcuate scale 13. The other device 21 comprises an arcuate row of short radially-extending light-emitting diodes outside the arcuate scale 13. The display representation is provided by energising an appropriate one of the LED's of the device 21, so that it indicates a value along the scale 12, and by energising LED's in the device 20 to provide an equivalent numerical representation of the same value.

The markings 12 on the plate 10 are illuminated by means of four filament bulbs 31 to 34 located around the edge of the plate. When the bulbs are energised they emit light which passes transversely of the plate within its thickness by total internal reflection. In this way, the markings on the surface 11 are illuminated but substantially no light, other than that reflected by the markings, emerges out of the plate.

With reference now also to Figure 3, the bulbs 31 to 34 are connected in parallel with one another in an illumination circuit 30 across the aircraft instrument illumination power supply terminals 35. As in common practice, the voltage at these terminals 35 is controlled by a manually adjustable rheostat

36 which also controls the illumination of other instruments and displays (not shown).

An additional bulb 40, identical in illumination characteristics to the edge-mounted bulbs 31 to 34, is connected in parallel with the bulbs 31 to 34 and is mounted within the display unit where it is shielded from ambient light and from any light produced by the bulbs 31 to 34. It will be appreciated that the illumination provided by the additional bulb 40 will vary in the same way as that provided by the bulbs 31 to 34 when the rheostat 36 is adjusted.

The display representation provided by the light-emitting devices 20 and 21 is controlled by a display driver or control unit 50. The unit 50 also controls the brightness of the devices 20 and 21 to produce a display representation of optimum brightness for the lighting conditions prevailing at the time. The display driver unit 50 receives input signals from two photodiodes 51 and 52, or similar light detectors.

The first of these detectors 51 is located so that it is responsive to the level of ambient light falling on the display and may be mounted behind the front plate 10, as shown in Figure 1, or on the outside of the display unit.

The other photodiode 52 is shielded from ambient light and from illumination provided by the edge-mounted bulbs 31 to 34 by being located within the display unit in close proximity to the additional bulb 40 so as to respond solely to the level of illumination provided by this bulb.

the driver unit 50 to increase the brightness of the light emitting devices 20 and 21. The outputs of the two detectors 51 and 52 are, in effect combined although the two outputs may be scaled to different degrees. In this way, when the user wishes to increase the brightness of the markings, at low levels of ambient light this, results in a corresponding increase in the apparent brightness of the devices 20 and 21 so that they are not obscured by the increase in brightness of the markings.

The display described provides complete electrical isolation of the illumination circuit 30 from the display driver unit 50 so that failure or faults in the illumination circuit will not alter the display representation. Also, failure of any of the bulbs 31 to 34 or 40 will not adversely affect the illumination of other displays in the aircraft. The illumination circuit 30 in the display unit is capable of operation with ac or dc supply without effecting the ability of the display unit to adjust the brightness of the light-emitting devices in response to high illumination levels of the reflective markings.

It will be appreciated that the invention can be used in other forms of illuminated display. For example, the light-reflective region may be

provided by a moving pointer. The light-emitting elements may be provided by one end of a fibre-optic cable the other end of which is optically coupled to a light source.

A similar system can be included in other forms of display unit in which the illumination of the reflective markings is effected automatically in response to a detector of ambient light levels.

CLAIMS

1. A display unit including a light-emitting element, a light-reflective region, first means for illuminating substantially only said light-reflective region, a first light-responsive detector arranged to provide an output indication of the amount of ambient light incident on the unit, a second light-responsive detector shielded from ambient light, second illuminating means arranged to illuminate the second detector, the second illuminating means having the same illumination characteristics as the first illuminating means such the said second detector provides an output indicative of the illumination provided by the first illuminating means, and control means arranged to control the brightness of the light-emitting element in accordance with both the level of ambient light as detected by the first detector and the level of illumination of the light-reflective region as indicated by the second detector.

2. A display unit according to Claim 1, wherein the first and second illuminating means are connected in parallel.

3. A display unit according to Claim 1 or 2, wherein the first and second illuminating means include filament bulbs.

4. A display unit according to any one of the preceding claims including a device by which the first illuminating means can be manually adjusted.

5. A display unit according to any one of the preceding claims,

including a transparent plate, and wherein the light-reflective region is a marking on a face of the plate.

6. A display unit according to Claim 5, wherein the said light-reflective region is a marking on a rear face of said plate.

7. A display unit according to Claim 5 or 6, wherein the first illuminating means is located at an edge of the plate to direct light transversely through the plate onto the marking.

8. A display unit according to any one of Claims 5 to 7, wherein the said plate is located in front of the light-emitting element.

9. A display unit according to any one of the preceding claims, wherein the light reflecting region is provided by reflective marking indicia against which the display representation of the light-emitting element is provided.

10. A display unit substantially as hereinbefore described with reference to the accompanying drawings.

11. Any novel feature or combination of featues as hereinbefore described.

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